

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The accompanying drawings, which are incorporated into and constitute a part of this specification, illustrate one or more exemplary, non-limiting embodiments of the invention and together with the description, serve to explain the principles of the invention. In the drawings:

[0015] **Fig. 1** is an exploded view of a first embodiment of three representative reaction zone modular cells of the present invention in a reformer stack showing the flow manifolding for both the catalytic combustion and the catalytic reforming zones of the reactor;

[0016] **Fig. 2** is an exploded isometric view of an embodiment of two bicatalytic separator plates and their associated combustion and reforming flow plates in modular assembly sequence for cells in a reformer stack of the present invention;

[0017] **Fig 3** is an exploded isometric view of an alternative embodiment of a pair of transverse-flow plate sub-assemblies employing support frames and gaskets to permit sealing to the bicatalytic separator plate;

[0018] **Fig. 4** is a section view taken along the line 4 – 4 in **Fig. 3** illustrating the support area provided to the gasket by the frame plate of the **Fig. 3** embodiment;

[0019] **Fig 5** is an enlarged isometric view of a portion of a transverse-flow plate fitted with a grooved flow-directing member or insert;

[0020] **Fig 6** is an enlarged isometric view of a transverse-flow plate fitted with a flow-redirecting member or insert in the form of a layer of spheres;

[0021] **Fig. 7** is a schematic exploded isometric view of a multi-cell plate reformer of the invention in completed stack configuration;

[0022] **Fig. 8** is a temperature and conversion graph showing the operation of the invention using a Pd-containing catalyst for combustion and reforming; and

[0023] **Fig. 9** is a temperature and conversion graph showing the operation of the invention using a Pd catalyst for combustion and an Rh catalyst for reforming.

[0024] **Fig. 10** is an isometric view of a corrugated separator plate. **Fig. 10A** illustrates a separator plate with straight channel corrugations. **Fig. 10B** illustrates a separator plate with corrugations in a herringbone pattern.

BEST MODE FOR CARRYING OUT THE INVENTION

[0025] The following detailed description illustrates the invention by way of example, and it is not in any way intended to limit the principles of the invention. This description will clearly enable one skilled in the art to make and use the invention, and it describes several embodiments, adaptations, variations, alternatives and uses of the invention, including what is currently considered to be the best modes of practicing the invention.

[0026] In this regard, the invention is illustrated in the figures enclosed herein, and it is of sufficient complexity that the many parts, interrelationships, and sub-combinations thereof simply cannot be fully illustrated in a single patent-type drawing. For clarity and conciseness, several of the drawings show in schematic form, or omit parts that are not essential in this drawing to a description of a particular feature, aspect or principle of the invention being disclosed. Thus, the best embodiment of one feature may be shown in one drawing, and the best mode of another feature will be called out in another drawing.

[0027] Likewise, in regard to the chemical process aspects, the invention is illustrated in the several examples, and is of sufficient complexity that the many aspects, interrelationships, and sub-combinations thereof simply cannot be fully illustrated in a single example. For clarity and conciseness, several of the examples show, or report only aspects of a particular feature or principle of the inventive process, while omitting those that are not essential to or illustrative of that aspect.

Thus, the best mode embodiment of one aspect or feature may be shown in one example or test, and the best mode of a different aspect will be called out in one or more other examples, tests, structures, formulas, or discussions.

[0028] All publications, patents and applications cited in this specification are herein incorporated by reference as if each individual publication, patent or application has been expressly stated to be incorporated by reference.

[0029] Reference will now be made in detail to the presently preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or similar parts. The present invention is described below by way of example by reference to its application to catalytic reforming of hydrocarbon fuels for the production of synthesis gas or hydrogen.

A. Catalytic wall plate reactor

[0030] The plate reactor of this invention comprises plural modular cells of the same or corresponding cooperating units, which include medial separator plates coated with combustion and reforming catalysts, stacked in coordinate relationship in sub-assembly units along with a transverse flow plate on each side of the bi-catalyst coated separator plate, so that there is at least one transverse-flow plate assembly between two combustion-catalyst-coated separator plate faces and at least one transverse-flow plate assembly between two reforming-catalyst-coated separator plate faces.

[0031] **Fig. 1** is an isometric exploded view representative of an internal section of a reformer stack, showing multiple modular bicatalytic separator plate reactor cells. A single cell of a plate reactor of the invention comprises a main unit **U**, in which reforming and combustion take place. A thin separator plate **1** is coated with a combustion catalyst, **C**, on face **1a** and with a reforming catalyst, **R**, on face **1b**.